Mars Hill Windfarm Post-Development Quarterly Sound Level Assessment Compilation -- Peer Review

MARS HILL, MAINE

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Review Basis

UPC Wind Management LLC/Evergreen Wind Power LLC (UPC) operates a 28 unit wind facility along the ridge line of Mars Hill in Mars Hill, Maine. At the request of the Maine Department of Environmental Protection (MDEP) this continuing peer review is undertaken to provide expert opinion as to:

> Whether the report provides a reasonable basis upon which to determine compliance or non-compliance with the operational noise limits set forth in the Control of Noise rules and the variance given in Department Order L-21635-26-A-N/L-21365-TG-B-N, dated June 1, 2004.

The post-development ambient and operational noise studies were completed by Resource Systems Engineering (RSE)[1] in December 2006 (ambient), May 2007 (ambient and operation), September 2007 (operation), January 2008 (operation) and May 2008 (ambient and operation). Each section of the October 15, 2008 report will be generally critiqued unless detailed criticism is given.

1.0 Overview

The stated primary objective of the sound level studies were to quantify sound levels from operation of the wind farm. The four rounds of quarterly sound testing were conducted under a variety of operating, site and weather conditions, representing all seasons.

Fourth-quarter testing incorporated periodic wind turbine shutdowns to measure ambient sound levels during operating conditions.

The compilation report synthesizes test data correlating atmospheric and turbine output for comparison to manufacturer specification and predevelopment model calculations.

2.0 Quarterly Operations Testing

Testing periods are summarized as representative with regards to operating conditions, wind predictions (GHA), seasonal variations and ambient conditions.

3.0 Compilation Of Quarterly Test Results

Selected data based on wind turbine prominence (field observation), surface wind data and level of turbine operation are presented by quarter.

Measurement locations (sound and meteorological) and local turbine output reporting parameters are summarized. Proximal vegetation at each monitoring location is discussed.

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[1] *Sound Level Study & Operational Sound Level Monitoring Maine Department Of Environmental Protection Order No.L-21635-26-AN*, Resource Systems Engineering

Prominent period wind turbine sound levels (L_{EQ} and L_{50}) are plotted by quarter with comparison to predicted levels. A brief discussion purports the L_{50} as more effectively representing wind turbine noise with the observation that operation sound levels (L_{50}) appear to compare more closely to the model based on turbine manufacturer mean sound production specifications.

Test results at all measurement locations did not show short duration repetitive or tonal sound elements as set forth in MEDEP 375.10.

4.0. Ambient Sound Levels

Ambient sounds from non-operations/maintenance activities for all measurement locations are presented for a wide range of meteorological conditions (as measured at Presque Isle airport and monitoring sites). It is noted by the reviewer that ambient sound levels are plotted against data collected from Presque Isle airport at a height of 10 m above the surface, without mention of wind speed variability/gustiness.

5.0 Summary of Findings

RSE concludes that measurement results were consistent during representative periods (4 quarters) using a MEDEP/peer review refined measurement protocol. And furthermore, that this "protocol" with associated refinements has provided a reliable methodology for determining, by measurement, sound levels from windfarm operations.

Predictive modeling factors are discussed with possible factors explaining predicted versus measured differences offered including manufacturer's uncertainty factor and possible differences between acoustic specifications (IEC) and ANSI field method measurement standards.

Ambient and windfarm operation sound levels vary with wind speed. Measurement locations representing protected locations tended to be exposed to lower wind speeds. Wind turbines sound was most prominent during light surface winds, as compared to wind incident at the turbine hubs.

RSE states, "Even with periodic turbine shutdowns, a direct comparison of operating and ambient (non-turbine) sound levels is complicated by the wide range of ambient sound levels that can occur during wind conditions that support moderate to full windfarm operations."

Upon request (e-mail dated November 18, 2008), RSE provided the MEDEP with a reorganized, subset of data presented in Figure 3-27 of the RSE compilation report parsed by hour at MP-8 -- WTs Prominent Hourly Operating L_{Aeq} vs Time MP-8. Sound levels from this data indicate greatest levels during nighttime hours (7 p.m.-7 a.m.), averaging

approximately 49±3 dBA, with outliers removed. It is noted by the reviewer that uncertainty remains incorporated in the data set.

Conclusion - (Peer Review)

The operations noise assessment (with evolving refinements) was performed during reasonably representative periods and was sufficiently conclusive to demonstrate MEDEP compliance in all but one measurement location representing protected locations.

The hourly MP-8 data provided, indicates 13 nighttime hourly L_{Aeq} values (during low ambient sound levels) in excess of regulatory limits. It is estimated by the reviewer to represent approximately 10-15% of operational nighttime measurements made during all four quarters.

The predicted modeling utilized by RSE, provided reasonably accurate estimates for windfarm citing in locations where predicted sound levels are well below regulatory limits. Predictive model variability was sufficient to require specifying a tolerance in future predictions.

Ambient data was evaluated during a broad range of meteorological and sound conditions. Periods representing the greatest potential wind turbine annoyance (prominence) occurred during nighttime hours under light surface winds when hub elevation wind speeds were sufficient for ≥60%.power generation.

Characterization of prominent wind turbine operation sound levels continued to be somewhat confounded by intermittent excessive (≥12 mph) wind speed variations (gusting), introducing non-operation spikes into results. It is noted by this reviewer that average anemometer readings alone do not sufficiently characterize wind variability to accurately assess the presence of significant microphone interference or localized wind activated source artifact under highly variable/gusty winds.

Various sound level metrics characterize requirements for regulatory control of noise produced by wind turbines in the eastern United States, but there has not proven to be a widely accepted, single parameter best describing wind turbine noise at the present. The L_{A50} is one of several commonly specified indicators, as is the hourly equivalent sound level (L_{Aeq}).

It is clear from research, the four quarters compliance testing data set and field observations (RSE) that wind turbine noise is prominent (≥60%.power generation) under light surface winds when the L_{Aeq} and L_{A50} are closely associated.

It is the opinion of the reviewer that this 4th assessment of the project indicates compliance at all bordering protected locations with only substantial compliance at the

protected location adjacent MP-8,, as established in the Control of Noise rules and the variance given in Department Order L-21635-26-A-N/L-21365-TG-B-N, dated June 1, 2004. The study is reasonable, and technically correct according to standard engineering practices and the Department Regulations on Control of Noise (06-096 CMR 375.10).

Recommendations- (Peer Review)

Future, windfarm sound level predictions employing the same methodology as those performed at Mars Hill by RSE should be evaluated with a possible ± 5 dBA range of variability.

Future compliance testing performed at protected locations likely to receive operation sound levels equaling or exceeding regulatory limits should be evaluated over a period sufficient to accumulate a total of 36 hours each of ambient and routine operation sound level data during conditions when surface wind speeds are ≤12 mph and nearby turbine hub level winds are sufficient to produce at a minimum, near-full sound power predictions as per manufacturer specification.

Sound monitoring devices should be positioned to most closely reflect each protected location (especially the residence), avoiding non-representative, localized, potential noise sources. Meteorological measurements should be generally position specific (but not necessarily in immediate proximity to sound monitoring instruments), unobstructed (where possible) and most importantly reporting average/maximum speed per unit time, representative of all wind directions.

Prominent, routine operation sound monitoring results should be reported for periods where maximum surface wind speeds are ≤12 mph and displayed together with maximum and actual hourly predictive sound levels based on hub level wind speeds and manufacturer's specification, less attenuating factors (as employed in the original predictive model).

Parameters to be reported:

> ambient sound levels should include, by site; hourly L_{Aeq} / $L_{A0,}$ etc. and average hourly unobstructed wind speed/maximum in mph at hub and surface (8' – 10') levels, and
>
> routine operations should include, by site; specific acoustic factors— maximum/actual hourly predictive levels, hourly L_{Aeq} / $L_{A0,}$ etc. and average hourly unobstructed wind speed/maximum in mph. Representative area NOAA meteorological wind data inclusion is strongly suggested.

Future wind turbine reporting should use a standard mph metric for wind speed; report average hourly wind turbine sound power level (respective nearby wind turbines), as per manufacturer specification (less attenuating factors) and hourly average sound levels in L_{Aeq} / $L_{A0,}$ etc.